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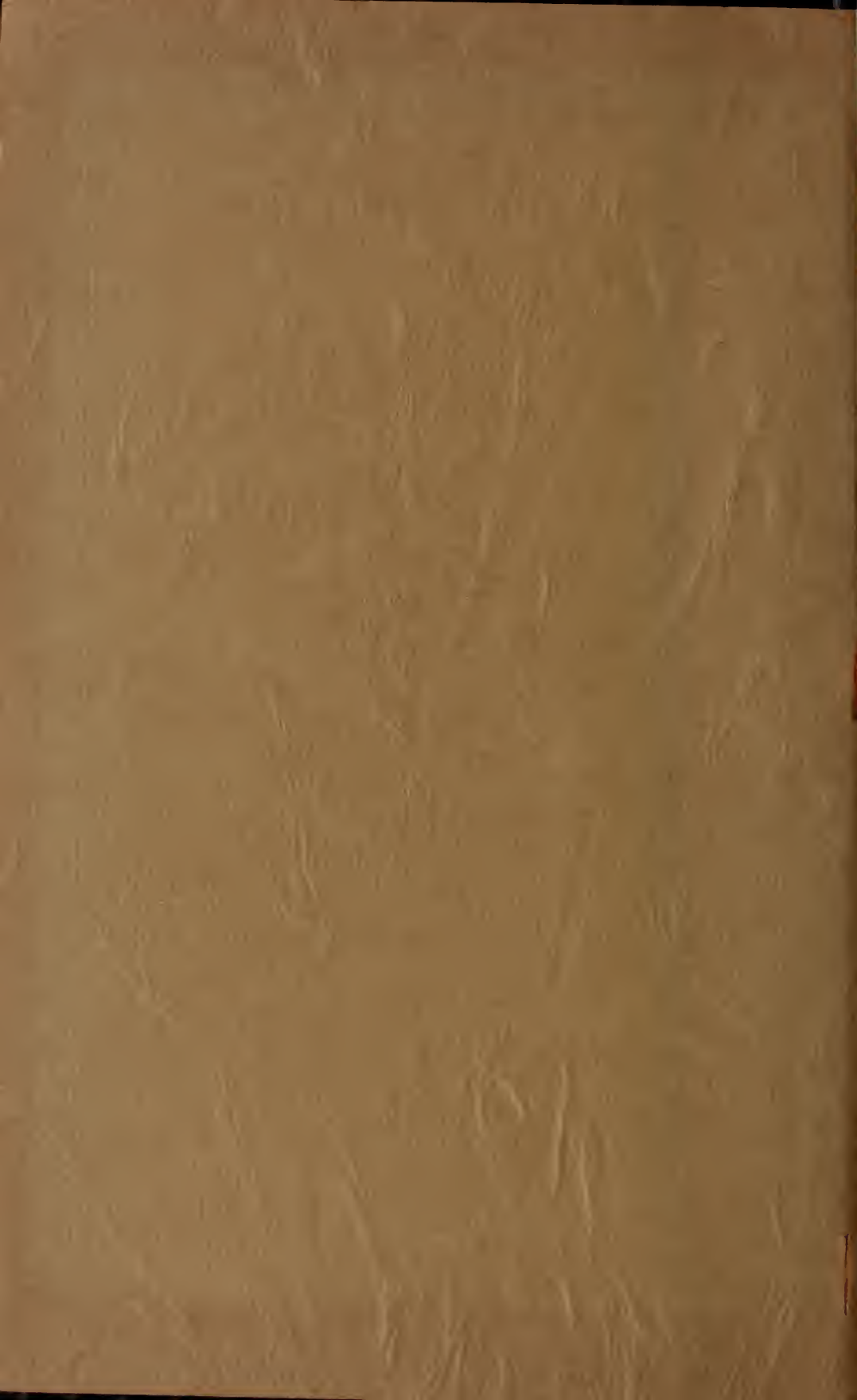
OF THE

**Canal Zone
Experiment Gardens**

**For the Fiscal Years
1931 and 1932**



THE PANAMA CANAL PRESS
MOUNT HOPE, C. Z.
1938



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LETTER OF TRANSMITTAL

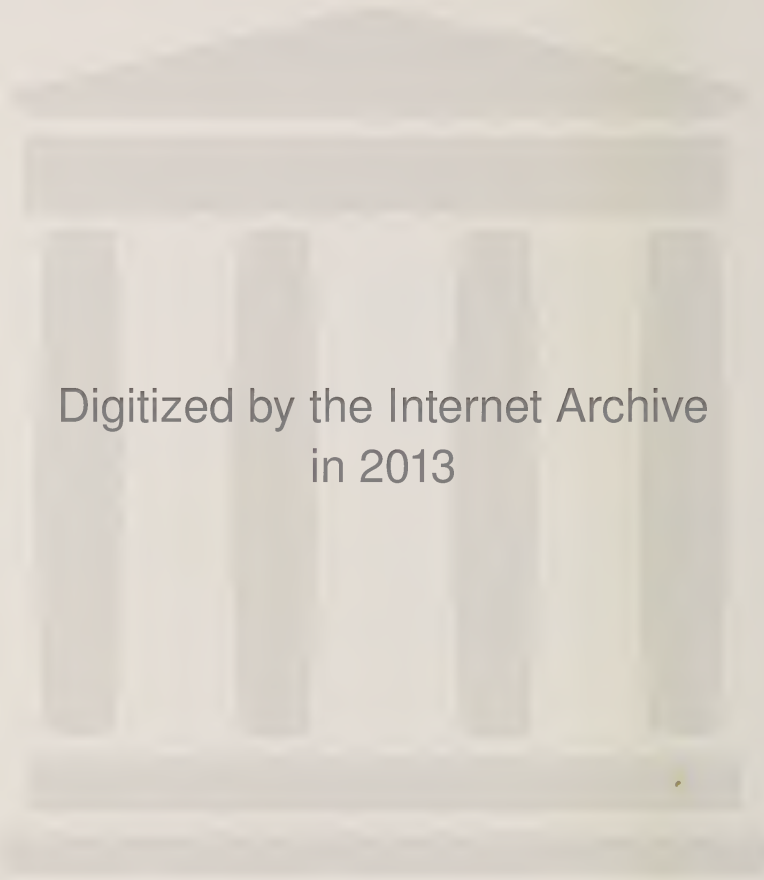
CANAL ZONE EXPERIMENT GARDENS,
Summit, C. Z., *July 30, 1931.*

SIR: I present herewith and recommend for publication* a condensed Report of the Canal Zone Experiment Gardens for the fiscal year ending June 30, 1931.

Respectfully,
J. EDGAR HIGGINS,
Director.

Mr. ROY R. WATSON,
Chief Quartermaster,
Balboa Heights, Canal Zone.
Through Mr. J. H. K. HUMPHREY,
Assistant Chief Quartermaster.

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PLATE I



Fruit of Mangosteen

Annual Report

OF THE

CANAL ZONE EXPERIMENT GARDENS FOR 1931

BY
J. EDGAR HIGGINS, *Director*

INTRODUCTION

The Canal Zone Experiment Gardens continue to grow more deeply into the life of the community. Its purposes are coming to be more clearly understood in the introduction, testing, establishing and disseminating of valuable plants; in the conducting of experimental work with plants and in fostering plant life in every way possible as a factor in community betterment and development. To this end the Gardens maintain exchanges of seeds and plants with botanic gardens, agricultural departments, experiment stations, and individuals in many parts of the world. The number of local visitors is increasing regularly, and each year brings a larger quota of visitors from abroad. Each year witnesses the coming to maturity of some plants not seen before in this part of the world, as well as the introduction of new species. Since water is being made available for use in the dry season, a large number of plants that have been awaiting opportunity are now being set out. Soon it will be necessary to expand the borders of the Gardens to make room for new plantings. The inflow of new introductions that are expected to be of value is maintained by exchanges through correspondence and by a policy of active personal collection in foreign countries on the part of the Director as opportunity offers.

PERSONNEL

About the beginning of the fiscal year, Mr. W. C. Dewey severed his connection with the Experiment Gardens to undertake work in the care of plants and grounds with the District Quartermaster of Balboa-Ancon. Mr. John E. Johnson was temporarily transferred to supervise the Experiment Gardens during the absence of the Director in Cuba and the United States. His appointment was effective about the first of July and continued until early in January.

On December 31, 1930, Mr. Walter R. Lindsay arrived to assume the duties of the Supervisor of Cultures. Having a background of horticultural and botanical education received in the University of Hawaii and in the State College of Washington at Pullman, Washington, as well as experience and familiarity with tropical plants in Hawaii, Mr. Lindsay comes well equipped to take up his new duties in the Canal Zone.

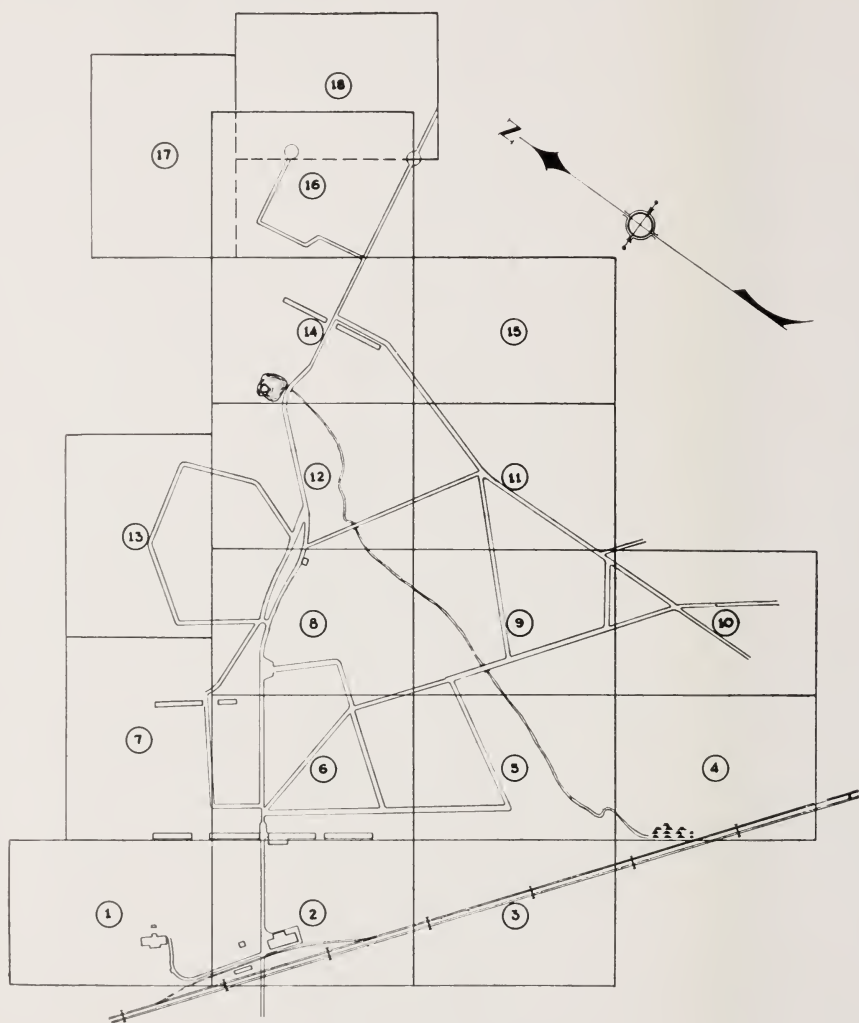
MAPS AND RECORDS OF PLANTINGS

In a large collection of plants including thousands of accessions widely allocated it is always a problem to keep accurate records, so that the history of every tree or plant can be fully traced. First it is necessary to know where every permanent specimen of any given accession is located among the plantings so that all may be found at any time. This is working from the office outward. Again it becomes necessary, when examining any specimen, to be able to trace it back to the records. It is important not only that trees and plants be labeled with their names so that anyone may know what they are, but also that the label bear an identification number which will connect it with the office records so as to determine when and whence it came and to reveal whatever data may have been recorded concerning it. It seems needless to say that all this is necessary, not only because of the fallibility of memory but also in order that such data should be available to any who may desire to study the plants and especially to those who in future years may be responsible for the care of the collections.

ACCESSION RECORD CARD					
SCIENTIFIC NAME				ACC. NUMBER	
Seeds, cutting, Plants Roots, Bulbs				Common Name	
Received					
Date	Amount	From	Address	Catalog Number	
Planted, grafted, budded					
Date	Place			Remarks	
Transplanted					
Date	Place				

FIGURE 1.—Accession Card

PLATE II



Key map to eighteen survey sheets

The system which has been adopted at the Canal Zone Experiment Gardens and which is being put into operation as effectively as possible may be described briefly as follows: An accession book is kept in which entry of each accession is made in chronological order and in numerical sequence. Each entry in addition to accession number and date of receipt, gives source, the scientific name and the common name, if any. This information and such other relative data as may have been received are transferred to a card which is filed alphabetically in the card catalog by genus with subdivisions in species. On this card future notes may be added as desired. The form of the card is shown in Figure 1.

When the trees or other plants are transferred from the propagation houses or nurseries to their permanent place in the Gardens, the exact location or locations must be recorded on the card. This requires mapping. During the year the Section of Surveys has completed the mapping of some of the principal plantings of the Gardens. Plate II shows the key map and Plate III shows Section "A" of Survey Sheet No. 6, one of the eighteen survey sheets or detail maps. It will be noted that survey sheets are divided into sections designated by letters. Each of these sections has a series of location numbers which proceed by multiples of ten, each number designating the location of a more or less permanent plant. The numbers intervening between the multiples of ten are held in reserve for any future plantings which may be made. It will be noted that these are not accession numbers but refer only to specific locations. Thus a card shows *Bambos tulda*, common name bamboo, accession number 578, with other data that may have been recorded, and indicates the locations of the individual plants, one of which is shown on sheet 6, section "A" Location No. 740. The exact location of No. 740 among the plantings can be determined at once by reference to the map. Each map is accompanied by a complete list of the plants which are shown on it, with their location numbers. Thus when a label is lost, an accident which sometimes occurs even with the exercise of the greatest diligence and watchfulness, it is an easy matter to determine exactly the identity of the tree, not only as to species and variety but likewise as to individuality and to refer at once to all records required in order to restore its proper label.

It will be noted that the name of the plant is not shown on the map. The chief reason for this is the lack of sufficient space in which to record legibly the somewhat long scientific names on maps in which there are many plants quite close together. On maps of orchards or any other plantings affording sufficient space, specific or varietal names can easily be inserted on blueprints for ready reference. The system that has been

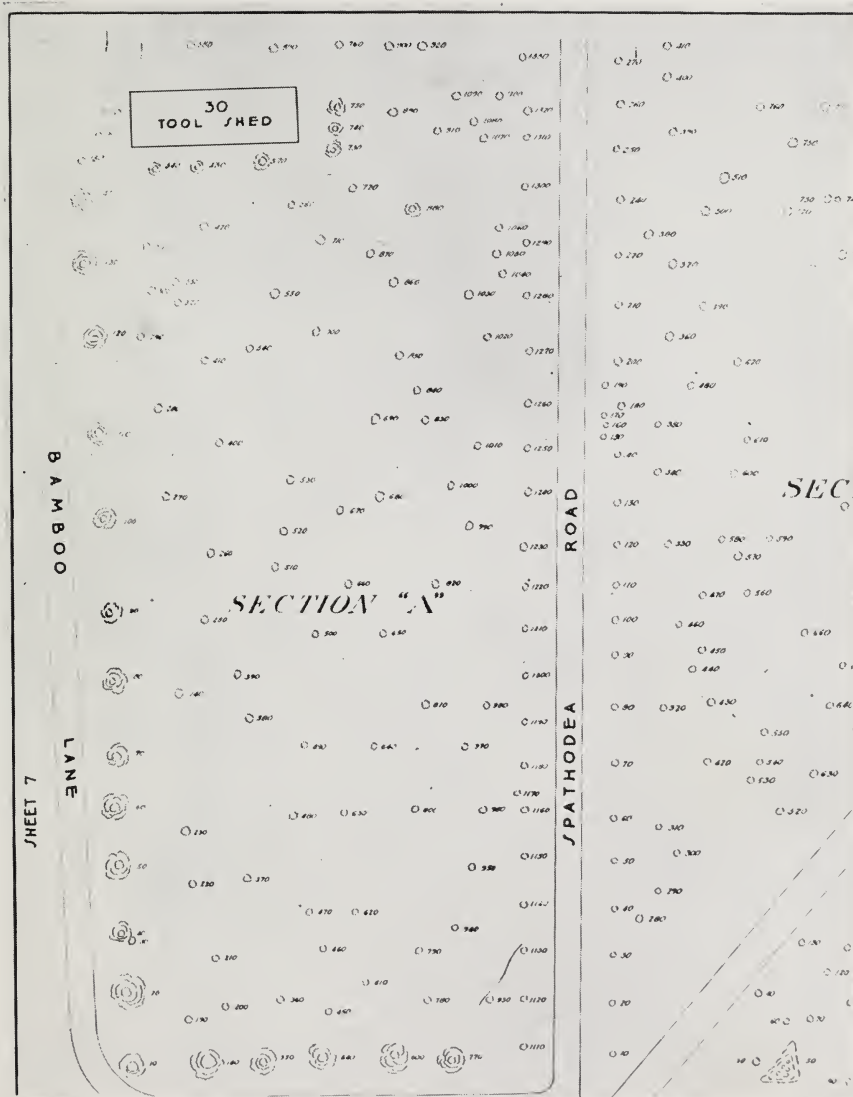
worked out for use here involves considerable office work but we have not yet found anything simpler which includes accuracy and availability of records.

Labels are an ever-present problem in most botanic gardens and experiment stations. The perfect label at reasonable cost has not yet been invented. Here several kinds are in use. One of these is a zinc plate about $4\frac{1}{2}$ " by 12", mounted upon a pointed strap-iron standard to which it is attached by bolts. On this the name, the number, etc., are stenciled in black. The standard is driven into the ground in front of the tree. The legibility is fairly enduring and the label serves well until by some accident it is knocked down and after a time is picked up by some thoughtful but uninformed person who places it in front of some other tree. Many of our trees are yet too young to have a slab of zinc of this size attached to them. Labels of embossed aluminum tape are being used on orchard trees and on many plants in the propagating houses. The embossing, which is done at the Gardens by a special machine for this purpose, is permanent and legible but the label is fragile especially at the point of attachment where the wire passes through it and consequently many are lost. Furthermore this label is not sufficiently conspicuous and easy to find on a large tree. Perhaps it might be attached by rust-proof tacks to a termite-proof slab of wood of sufficient size to be conspicuous. Wooden pot labels, everywhere subject to rapid decay, become of the most temporary value here in the tropics. At some botanic gardens, the zinc pot label is being used with a good degree of success. On this the inscription is made with a pen dipped in a five percent solution of platinic chloride.

THE MANGOSTEEN (*Garcinia mangostana*)

The Mangosteen (Plate I) is one of the most highly prized fruits of the Oriental tropics, being native to Malay and the East Indies. The fruit is nearly spherical but slightly flattened, presenting a five to seven rayed, star-shaped marking at the apex, as shown in the illustration, and a characteristic collar composed of a four-parted persistent calyx surrounding the green stem, which is about three-eighths of an inch in diameter. The fruit is about two and five-eighths inches in diameter, is dark purple in color when ripe and bears some resemblance externally to the purple star-apple (*Chrysophyllum cainito*) but is more handsome. The rind is thick and tough, affording excellent protection to the white pulp which is in segments and easily removed, affording a delicate morsel of unique flavor. The Mangosteen was introduced into the Isthmus even before these Gardens were in existence by Dr. David

PLATE III



Detail map of Section "A" of sheet 6



Fairchild, then Chief of the Office of Foreign Plant Introduction of the United States Department of Agriculture. Two or three of the first trees were planted at Frijoles and have produced some fruit for several years. The progress of those at the Experiment Gardens has been watched with deep interest. The trees have made excellent growth and in June and July of 1931, about six years from planting, several have yielded a few fine fruits. This is considered rather precocious for mangosteen trees and together with their vigorous, healthy and undisturbed growth, gives much promise for the future. As no insect pest or plant disease here is known to menace seriously the trees or their fruits there should be no difficulty in shipping them into the United States. The tree being strictly tropical, production in Panama can never come into competition with similar fruit produced in the United States but may be expected to meet some competition from other countries of the Caribbean region, although no extensive plantings have yet been made in the Western Hemisphere. Observations upon the behavior of the trees at Summit have led to the belief that they are much more adaptable to atmospheric and soil conditions within the tropics than has been commonly supposed. In wet soil they have kept on growing through the rainy season and in dry season before irrigation water was available in sufficient quantity, the mangosteen trees appeared to suffer less than some of the other fruit trees. Also shade has been regarded as a requisite. Here, in the early years of their growth in the orchard, the trees were shaded by various devices and such leaves as were exposed by the breaking down of the shade frames, showed considerable sunburn but during the past two or three years no shade has been maintained and there has been no appreciable evidence of injury.

One obstacle that has retarded progress in the dissemination of mangosteen trees, for which there has been much demand in the Isthmus, has been the difficulty of securing sufficient seed. The seed is quite perishable and unless specially packed can not endure the long shipment from the Orient. Also there are few if any seed merchants handling tropical seeds in the countries where the mangosteen abounds. The mangosteen seed, like that of many other tropical fruit trees, cannot endure severe drying and, on the other hand, is easily destroyed or germinated by too much moisture. Hence it becomes necessary to pack the seed in coconut fiber dust or similar medium with just sufficient moisture to prevent its shriveling.

There has been considerable speculation and some experimentation among tropical horticulturists on the subject of possible stocks upon which to bud or graft the mangosteen. Although apparently good

unions have been effected upon several species no other species has come into prominence as a stock and the most of the trees now growing are on their own root system. It is possible that some other stocks may be found to be of value to bring about a wider adaptability to soils and climatic conditions and it is not unlikely that the budding of selected varieties upon mangosteen roots will become important. In the conditions existing at Summit the mangosteen root itself seems quite satisfactory. Because the fruit of the mangosteen is well protected with a very thick rind and can be shipped long distances and because of its unique appearance and delicate unusual flavor and texture it is quite likely to become a tropical speciality in the markets of the United States and Europe as well as in those nearer to the tropical countries where it can and will be grown.

THE HAWAIIAN COOKING BANANAS

The cooking bananas, as they are commonly called in Hawaii and other islands of the Pacific, are like plantains in their culinary uses but are quite different in appearance and in quality. There is a considerable number of varieties of these, the more important being classed in the Maoli group. These are characterized by rounded fruits of large size and blunt or rounded ends, quite in contrast with the pointed or horn-like fruits of the plantain of the West Indies and Central America. Two or three varieties of this group were introduced from Hawaii early in 1929, and some of these have fruited. Plate IV, Figure 1, shows a bunch of one of these varieties known as the Manaiula. This bunch of 132 fruits in 9 hands weighed 70 pounds. These fruits were distributed among officials on the Isthmus for trial and to learn how this new introduction might compare in public favor with the plantains that are well known and much used here. They were pronounced excellent and by nearly all were considered far superior to any plantain that they had eaten. In fact they are in a class by themselves. If allowed to become thoroughly ripe, even to the degree of the blackening of the skin, this Manaiula variety of banana when baked is a most delicious food used either as a vegetable, like baked plantains, or with cream and sugar as a dessert fruit. One of the favorite methods of cooking these bananas is to bake them in the skins. They are sometimes baked in honey. As the Manaiula has prospered so well here, the Gardens will now propagate this and other Hawaiian varieties as rapidly as possible for dissemination. Another variety of the same group which has fruited here is the Eleele. In quality it appears to be equal to Manaiula.



FIGURE 1.—Hawaiian Cooking Banana variety Manaula



FIGURE 2.—*Spathodea nilotica* forming a new head after being cut back to a stump



PINEAPPLE—VARIETY CAYENNE ("Hawaiian")

In the latter part of October 1929 about three thousand slips and suckers of Cayenne pineapple were received from Hawaii. This is the variety upon which the Hawaiian pineapple canning industry is founded and because of the leading place which Hawaii has taken in pineapple canning and the prominence which it has given this pineapple, the variety is often spoken of popularly as the Hawaiian, although the recognized name is Cayenne. The plants were set out promptly when received, but they had only two months of good growing weather before they were overtaken by the dry season. No irrigation water was applied. However, the plants have made good growth and began to ripen fruit in June 1931, twenty months after planting, but many of the strongest plants have not yet fruited. This result is about the same as that experienced from October plantings in Hawaii. In fact the period required for maturity in the Isthmus appears to be rather shorter than in Hawaii, probably due to the fact that weather conditions here are ideal for growth from the beginning of the rains in April or May until the first part of January, for even after the rains have ceased there is sufficient soil moisture for optimum growth of the pineapple for several weeks. In the major portion of the Hawaiian pineapple belt, growth is retarded and the plants lose their normal green color during several months because of a lack of sufficient heat. In Panama, on the Pacific slope, the time required for maturity could be further shortened by irrigation during a few months of the dry season, while in the moister conditions of the Atlantic slope there would be very little time when irrigation would be of any benefit. In flavor, texture and general appearance the Cayenne pineapples, grown at Summit, do not appear to be inferior in any way to the high standard of excellence that has been attained in Hawaii. Some of the fruits of the Cayenne and of the Queen variety which has been mentioned in earlier Reports, have been delivered to the Commissary Division and are reported to have found a ready sale at prices considerably higher than those received for other varieties. Both the Cayenne and the Queen have received very high praise. It will be possible to disseminate a considerable number of plants during the present year.

THE SOLO PAPAYA

The Solo Papaya, another introduction from Hawaii, has been mentioned in earlier Reports. During the year just closed, it has been grown in sufficient quantity to get the opinion of many residents of the Zone with whom it has found the highest favor. Many have pro-

nounced it to be in a class entirely by itself and superior in flavor and texture to any other papayas that have been tried. Many plants and a large quantity of seed of this variety have been disseminated in the Canal Zone and Panama and seed has been used in exchanges with many parts of the world.

SUGAR CANE DISSEMINATIONS

It has been mentioned in one or more of the earlier Reports that a function which the Gardens are performing consists in the introduction and dissemination of new varieties of sugar cane that may be better adapted than the old varieties for Panama. Slightly under thirty-six hundred canes have been sent out. As these would average at least five cuttings per cane, it is estimated that they represent approximately eighteen thousand cuttings.

The canes that have been distributed during the past few years have demonstrated their value and created a demand for more. The varieties for which there has been the most call are P. O. J. 2725, P. O. J. 2714, and more recently P. O. J. 2878, which as noted elsewhere has been highly successful in Cuba.

Calls for the supply of sugar cane cuttings have come also from several of the neighboring republics.

OTHER NOTEWORTHY PLANTS OF THE YEAR

Among the plants that have become sufficiently established to attract special attention during the year a few may be mentioned. A shade tree, *Spathodea nilotica*, should be noted here. Its congener, *S. campanulata*, the Tulip Tree or African Fountain Tree, is better known and is greatly admired wherever it prospers. The species *nilotica* although botanically distinct appears to be very similar to its better known relative but from the practical point of view of the horticulturist and landscape architect, its chief value appears to be in the fact that it tends to hold an abundant supply of green foliage and brilliant flowers at a time in the rainy season when *S. campanulata* is only sparsely clothed with over-ripened foliage and has no flowers (Plate VI, Figure 2). If planted as companion trees, it appears that they would maintain a good supply of foliage and flowers throughout most of the year.

The Julie variety of mango, introduced from Trinidad early in the history of the Gardens has come to fruiting this year for the first time in the Isthmus. Its fruit (Plate V, Figure 1) is of large size, somewhat flattened, free from fiber and of very delicious flavor and texture. It has been pronounced excellent here by those who are thoroughly familiar with the best Philippine mangoes.

PLATE V



FIGURE 1.—The Julie Mango



FIGURE 2.—Sugar cane variety P. O. J. 2878, eleven months after planting

p. 14—a.



Among the outstanding ornamental plants of the year should be mentioned *Congea tomentosa*, a strong growing, vigorous vine, presenting a mass of magnificent pink-purple clusters of bracts and remaining in flower for several months. As cut flowers, for decoration, they are a great success because they retain their beauty for many days. *Congea* has flowered here for two or three years but this year a vine came into flower for the first time at a season when the flowering of the original plant was about over. If this proves to be a permanent character, the season for *Congea* can thus be extended to cover more than six months of the year. Fortunately *Congea* is easily propagated by cuttings.

Other new flowering plants that have been universally admired are thirty or forty varieties of Hawaiian hibiscus. An exhibit of these exquisite creations in plant life was made in a show window at the Balboa Commissary and drew large numbers of admirers. The collection included many shades of red, pink, and yellow, and also pure white single and double flowers. Most hibiscus flowers last less than one day and only a few persist until evening. A peculiarity lies in the fact that a flower which on the plant lasts only one day or until late afternoon, will remain in good condition quite as long or longer if cut and removed to the house. Also it lasts as long without water as when water is provided. Because of the rapid wilting of hibiscus flowers and the fact that they always open in the early morning, they have not usually been considered available for evening decorations or even for late afternoon use. However, following a practice which seems to have developed in Hawaii, it has been found quite practicable to use hibiscus flowers in the evening. For this purpose it is only necessary to gather the unopened buds before daybreak, lay them carefully in shallow pasteboard covered boxes, and place them in an ordinary iced refrigerator thus keeping them cool and in the dark until the hour when they are to be used in decoration. They open immediately in daylight or in electric light and retain well their beauty for six or seven hours. As the flowers need no water, they are mounted on the prepared midribs of the mature leaflets of the coconut palms. Hibiscus branches freshly cut and preferably without too much new and tender growth may be placed in water in the vase with the flower supports to give a natural background for the flowers.

NURSERY OPERATIONS AND GENERAL SALES

The operation of the nursery as a separate and self-supporting department, carried on at the Gardens, under the Revolving Fund, has been explained in earlier reports. It has proved to be one of the most important services which the Gardens can render here in the center of a

vast undeveloped agricultural region where there are no commercial nurseries to supply these classes of nursery stock. From the nurseries of the Gardens the progenies of many plant immigrants find their way into different parts of the Canal Zone, Panama, and the neighboring republics. The total number of plants disseminated during the year ending June 30, 1931, is 18,323, including approximately 3,600 sugar canes of the newly introduced varieties. There were approximately 3,000 grafted or budded fruit trees of mango, avocado and citrus. Not included in the above are 1,098 sacks of cuttings of grass for use on lawns and the binding of the shoulders of roads, principally the new Madden Road. The nursery also sold 65 sacks of sterilized prepared soil for use in pots and boxes for house plants.

In nursery practice some slight changes have been developed. In the grafting of young mango seedlings, a tongue graft has in part replaced the crown bark graft that has been in use for some years. This tongue graft is inserted on the side of the stock and the latter is not cut off until the scion has united. Thus if the scion fails, the stock remains in good condition for another grafting. In avocado propagation, the general trend is towards the growing of trees in nursery row rather than in tubes or tiles as formerly, although a few are still grown in concrete tubes to satisfy a limited demand. Experiments are still in progress with the seedling graft in the herbaceous stage as a method for extensive nursery practice.

IRRIGATION INSTALLATION

In the annual report for 1930, reference was made to the special allotment of about \$14,400 for the installation of an irrigation system, approximately one-half of the amount to be expended in the year 1930 and the balance to be available in 1931 and thereafter. The work performed in the first year has been described in the report for 1930. In 1931, the Municipal Engineering Division, with the aid of the Gamboa labor gang at the Gardens, laid about 3,000 feet of six-inch cast-iron pipe, connecting with the main line which runs approximately parallel to Spathodea Road, the principal concrete road passing through the Gardens. Approximately 1,800 feet of this pipe lies on the north side of this road and conducts water to one of the principal nurseries in Division, or Sheet 7 shown on the survey key map (Plate II); also to a high promontory in Division 13 (Plot 3); and through Divisions 16, 17, and 18 to the citrus orchards and to new plantation of avocados, papayas, and nursery stock. About 1,200 feet of the six-inch cast-iron pipe was laid from the main line through Divisions 12, 11, 9, and one corner of Division 5, there connecting with a small line of the old system

PLATE VI



FIGURE 1.—*Casuarina equisetifolia* in Havana, pruned as a formal street tree



FIGURE 2.—*Spathodea nilotica*.—The tall tree to the left in flower and full foliage;
S. campanulata, tallest tree to the right, in seed but very little foliage



still intact. In all of this 3,000 feet of pipe line, crosses with plugs or valve outlets were installed at suitable distances so that smaller pipe may easily be connected for further distribution. There remains an unexpended balance of approximately \$3,550 with which to make necessary extensions and branch lines.

BUILDINGS

The shade house at the upper or east side of the Gardens has been rebuilt by the Constructing Quartermaster during the year. The old building which was about 150 feet long by 16 feet wide was constructed many years ago when the present site of the Gardens was used for a poultry farm. It had become so dilapidated that rebuilding was necessary. The new construction of the same dimensions was made in the form of a slat house of the same general type as those built at the lower end of the Gardens in 1929 and with a small part of one end covered with a corrugated iron roof to provide a work shed. This type of shade house with grooved slat roof to prevent the dripping of water upon the plants has proved quite satisfactory in operation but its durability is yet to be determined. All lumber was treated with the usual dip to render it, to some degree, resistant to termites and to decay.

The house which was constructed of galvanized iron pipe and wire trellis in 1928 is now quite well covered with vines and should give good service for many years. The most rapidly growing vine on the house is *Tetrastigma hermandii*. This is a vine, long-lived, very vigorous, and to date uninjured by any insects or diseases. It tends to make a shade rather too dense and must be pruned to admit sufficient light.

An overhead irrigation system has been installed during the year in all of the plant houses except the one that has just been rebuilt. Not only is this a great saving in labor during the dry season but it insures a much more uniform and efficient distribution of water than is possible by the use of the hose. The effects are clearly to be seen in the plants.

Minor repairs have been made on the office building, chiefly because of termite attacks.

EXTENSION ACTIVITIES

The Gardens, through the Director, have continued to render service to the Canal Zone towns, the U. S. Army posts, and the Fifteenth Naval District, by way of advice concerning planting plans for new areas and in relation to the care of trees, shrubs, and vines in the older and established settlements.

GAVILAN AREA TOWNSITE

The chief single piece of work in the way of landscape planning accomplished during the year has been the laying out of plans for the planting of the Gavilan area townsite, an extension to Balboa. These plans consisted of designs for street tree planting and also for trees and shrubs for the yards or little gardens surrounding each house. The map work recording these designs has been done through the cooperation of Mr. H. R. Stettin who was designated for this service by the Office Engineer. The streets, sidewalks, automobile runways approaching the houses, lampposts, etc., had already been laid out by the engineers and the work had been completed with the building of the houses before the question of planting designs was taken up. Briefly it may be said that the general layout consists of a 35-foot roadway on Gavilan Road, 20-foot roads elsewhere, and 4-foot sidewalks separated from the roads by a curbing and a 5-foot grass plot. The houses which are of the design for two families are located about 25 feet from the sidewalk. A 4-foot concrete walk at each end of the houses leads from the sidewalk to the front steps. Four 2-foot ribbons of concrete for automobiles lead to the two garages located in the concrete basement of these houses. The roofs have a heavy overhang for the necessary protection of the walls and windows from the tropical sun. This makes a space of about four feet of soil surface which receives very little rainfall. The shrubbery has been planted almost entirely outside this area so as to benefit by the rainfall. This arrangement leaves an excellent spot back of the regular shrubbery for the growing of such shade-loving plants as ferns, caladiums, alocasias, dieffenbachias, and others in which the tenants may be specially interested. The groups of shrubbery have been placed chiefly with a view of giving an easy, informal, home-like effect and providing a natural screen to afford privacy in the open basements. These groups have been placed chiefly within a belt about 14 feet wide just outside the drip from the roof. Hedges have been avoided except as screens for clothes lines in the rear of the houses.

The plants used in the group plantings have included many that are uncommon, and some of them new in Canal Zone plantings, such as *Cryptostegia madagascariensis*, the Madagascar rubber vine or shrub, *Melastoma*, a very beautiful free-flowering shrub with dark pink blooms, a bright shiny green, strong-growing *Cordyline*, several unusual *Dracaenas*, *Chrysalidocarpus lutescens*, the yellow palm or Madagascar palm, and several new and beautiful varieties of hibiscus.

The trees for street plantings are of kinds that are of special attraction because of their magnificent displays of flowers. These trees have been

placed about six feet from the inner edge of the sidewalks where with proper training, they should provide shade for the walk without being in the way of pedestrians. On Gavilan Road the prevailing tree is *Cassia nodosa*, the pink-and-white shower, the branches of which are literally covered with flowers like apple blossoms which persist for many weeks about the beginning of the wet season. On Akee Street, the flowering trees are *Spathodea*, probably *S. campanulata*, the African Fountain tree or Tulip tree. It is not impossible, however, that some of these trees may be hybrids for the seed was collected where trees of *S. nilotica* were close enough to cause cross-pollination. Both of these *Spathodeas* have attracted much attention at the Experiment Gardens and have been greatly admired. On Almond Street have been planted trees of *Cassia fistula*, the Golden Shower. Of this there is at present only one really good representative in the Zone towns of the Pacific slope. This tree which stands in front of the Balboa Fire Station is probably familiar to all residents because of its large pendant clusters of yellow flowers which make it an object of conspicuous beauty for many weeks at the close of the dry season and during the first of the rains. Calabash Street has been planted to *Guaiacum officinale*, the true Lignum-vitae, the source of perhaps the hardest wood in commerce. This species also is represented in this immediate vicinity by only one mature specimen so far as we know. This is located in the Santa Ana Plaza in Panama City. The tree is of good form, retains green foliage throughout the year and in season is well supplied with beautiful blue or purple flowers.

On the streets where *Cassias* have been planted, these have been omitted in the spaces immediately in front of the houses and have been replaced by trees of more upright habit such as *Eugenia malaccensis* and *Acacia auriculiformis* which will rapidly attain a sufficient height to afford some shade for the houses.

Other trees, some of quite large habit, have been planted where sufficient space is afforded between and about the houses. Among these may be mentioned the majestic native Espave, *Anacardium excelsum*, and the Palo Maria, *Calophyllum calaba*. The very beautiful little pal'm, *Seaforthia elegans*, has been placed on the sides of the roads, just at the entrance of the automobile runways.

Requisite Care of These Trees:

Some of the shade trees recently planted in the Gavilan area are of such habit as to require very careful attention and training during the first few years of their growth in order to induce an upright form. The natural tendency of both species of *Cassia* is to spread near the ground

while young. If trained straight up to a stake, for two or three years, they will assume good form for street trees and afford shade on the sidewalk. Side branches below five or six feet should be persistently removed or cut back so as to retard their growth and force the straight upward growth. When the main stem of the tree becomes three or more feet high, we find that leaving a few side branches, cut back within a few inches of the stem, tends to reduce the number of new side shoots and will strengthen the main trunk. The side shoots can be cut off close when the main trunk is well established and the wounds will heal without injury to the tree. The *Spathodea* trees will not require so much attention to induce an upright form and may even need to be headed back after a few months to keep their branches sufficiently near the ground. The *Spathodeas* are magnificent trees when young and are universally admired with their clusters of large, red tulip-like flowers which give rise to the name Tulip-tree. While comparatively young, often as early as nine or ten years, they may begin to lose their beauty of form by the dying of the lower branches, especially if the trees are crowded. Fortunately, however, these trees lend themselves readily to a renewal system and if carefully cut back so as to avoid splitting and bark injury, the wound being covered with asphalt paint, the trees will send out new branches and form a new head. Plate IV, Figure 2, shows a *Spathodea* tree which was cut back a few months before the photograph was taken for reasons other than those stated above and much lower than would be recommended for street tree treatment. It will be seen that a profuse growth of new branches has been sent out and from these a new head could easily be formed.

COCO SOLO

Another extension service has been in connection with the plantings of the new Naval Air Base at Coco Solo. Several consultations on the subject have been held with Lieutenant C. W. Coryell, the Engineer-in-charge of construction. Two or three visits to Coco Solo have been included.

Similar, although less extensive, attention has been given to horticultural problems at the Submarine Base, Coco Solo, at Fort Sherman, Fort Clayton, Quarry Heights, and Albroom Field.

ROUTINE INSPECTION CALLS

Inspection calls concerning trees and plants in the Canal Zone towns have been made quite frequently, some of them being for the Government and others for private parties. Trips have been made as usual to a number of farms on the lake to give advice or suggestions.

REPORT OF A TRIP TO BOTANIC GARDENS AND SIMILAR INSTITUTIONS IN THE UNITED STATES AND CUBA

BY THE DIRECTOR

An abridged form of a report, with illustrations, presented for file and for official reference.

I was absent from the Isthmus on official business from August 3 to September 21, 1930. I sailed from Cristobal on the S. S. *Ulua* and disembarked at Havana on August 6.

CUBA

In Cuba I visited first the Cuba Sugar Club Experiment Station at Baragua. This experiment station, under the direction of Mr. D. L. Van Dine, is devoted exclusively to the problems of sugar-cane culture and has developed results of great significance to the sugar interests of Cuba and likewise to those of Panama. Notable among these are the achievements in the determining of suitable and disease-resistant varieties of cane and the devising of methods for their very rapid multiplication and dissemination. One of the chief agricultural obstacles in the way of a successful sugar industry in Cuba, as in Panama, has been the prevalence of cane diseases. The older varieties there, as here, have been extremely susceptible to disease, especially to Mosaic. Several highly resistant forms have been found, notably among the Java or P. O. J. varieties. One of the most interesting features of the work from the standpoint of Panama's cane industry, is the rapidity that has been achieved in multiplying planting material. On July 29, 1927, a cutting of the variety P. O. J. 2878 consisting of three buds or "eyes" was received at the Experiment Station. This represented the entire stock of the variety in Cuba at that time. After experimenting rather unsuccessfully with propagation by shoots as a means of rapid multiplication, a method of propagation by single-eye cuttings was worked out. This has been so successful that, in 1930, it was estimated that 30,000 acres of this variety were under cultivation in Cuba, all the progeny of three eyes or buds introduced three years earlier—thirty thousand acres from three buds in three years. The methods worked out by the Experiment Station in Cuba are described in full by the Director.* Briefly it may be stated that this highly successful method consists in forcing a rapid growth of vigorous stools from which canes are removed for seed purposes as soon as each will produce an

* Van Dine, D. L.: The intensive propagation of sugar cane for seed purposes. *Asociacion de Tecnicos Azucareros de Cuba*. Third Annual Conference Proceedings.

average of about ten buds or "eyes." Such young canes are divided into single-eye cuttings each of which is planted as the beginning of a new stool. As soon as the new stool has developed sufficiently, it is used as a source of more planting material to be handled in the same manner. In the meantime ratoon canes from the first stools have developed and these in turn are removed, converted into single-eye cuttings and planted out. Thus the process is carried on making use of all canes as soon as they have arrived at a sufficient degree of maturity to carry out the plan as it has been worked out.

On the part of some cane growers in Panama, there has been a very natural desire to import seed cane in large quantities to replace as rapidly as possible the old and failing varieties. This practice, however, would be fraught with the danger of introducing cane diseases, new to this country. The most outstanding varieties that have proved successful in Cuba, Puerto Rico, and Hawaii have been introduced by the Canal Zone Experiment Gardens and have been disseminated in small lots among planters in the Republic of Panama. It now remains only to multiply these extensively on the plantations by the methods just referred to and it will be only a matter of a year or two when the failing varieties can be replaced entirely. Other varieties will be introduced experimentally with the usual precaution in order to avoid insect pests and plant diseases.

The variety P. O. J. 2878, mentioned above, is proving to be of leading importance in Cuba. A growth of eleven months at Baragua, Cuba, is shown in Plate V, Figure 2. This appears to be a very promising variety for Panama also but it is yet too soon to know with certainty what place it must take under conditions here.

HARVARD BOTANICAL GARDENS IN CUBA

The Harvard Botanical Gardens, under the direction of Mr. Robert M. Grey and located on the Soledad Estate at Cienfuegos, Cuba, have brought together such a remarkable collection of tropical economic and ornamental plants that many days would be required to get an adequate view of what has been achieved there and to collect the seeds and other propagating material that is so freely offered to the Canal Zone. I hope to make at some future time a special visit to Cuba for that purpose, as the crowded schedule of the trip last August and September permitted less than one full day at Soledad. Through the courtesy and personal attention of Mr. Grey it was possible to make a tour through the Gardens, collecting seeds of several species and noting very many others that must be obtained for the Experiment Gardens at Summit, when opportunity offers.

PLATE VII



FIGURE 1.—Some of the plantings and a group of buildings at the Plant Introduction Garden at Coconut Grove, Florida



FIGURE 2.—Arnold Arboretum showing a vista along one of the principal drives



One of the most striking features of the landscape in parts of Cuba is the Royal Palm (*Roystonea regia* Cook) standing in magnificent groves frequently where nature has placed them. In places they form thickets with their stately trunks and graceful foliage and are so abundant as to furnish in their seeds a valuable feed for hogs, while the leaves are sometimes cut and laid on the ground to form a mulch in citrus orchards. The "heart" or central tender growing portion furnishes the highly prized "palm-cabbage," perhaps not less delicious as a salad than that of its close relative of other West Indian islands, the Cabbage palm (*R. oleracea* Cook). One such feast, however, represents the sacrifice of the whole tree and it is said that the Government of Cuba has sought to protect these magnificent trees by the passing of a law prohibiting the cutting of them.

Havana has featured the formal type of landscape gardening in its use of certain varieties of street trees which are common in Panama and the Canal Zone in their natural forms. Notable among these trees may be mentioned the so-called Australian "pine" or Australian "oak" (*Casuarina equisetifolia*) which, as shown in Plate VI, Figure 1, is pruned in very exact and uniform shapes. The *Ficus nitida*, or "Chinese banyan," so familiar to the people of the Canal Zone because of the universally admired specimens on Roosevelt Avenue, is another tree which receives the same formal treatment in parts of Havana. In this formal treatment, as well as in the natural form, the effect is beautiful. Under conditions prevailing in the Canal Zone, however, the natural form would be preferred.

FLORIDA

On Tuesday, August 12, the journey was continued to Miami, Florida, and on the morning of the 13th to the United States Plant Introduction Gardens at Coconut Grove. This is the principal sub-tropical plant introduction garden of the Office of Foreign Plant Introduction of the United States Department of Agriculture and is under the immediate superintendence of Mr. Edward Simmonds. Plate VII, Figure 1, shows some of the plantings and a group of buildings at this Garden. Here have been brought together plants of practically all the tropical and sub-tropical species that have been introduced by the Federal Government. In view of the fact that the Office of Foreign Plant Introduction, now under the direction of Mr. Knowles A. Ryerson, has always manifested the utmost willingness to place plants in the Canal Zone for trial, Chapman Field was obviously one of the most important places to be visited in relation to plant introduction on the

Isthmus of Panama. The Gardens are located at Coconut Grove in South Florida on land that is of coral formation with much coral rock. One of the interesting features of the region is the luxuriant growth made by trees and shrubs when they have once become established in this rocky soil.

Very many plants which were freely offered for use in the Canal Zone were selected and arrangements were later made with the Washington Office for the shipment of these to Cristobal. It was expected that these would be shipped via New Orleans but it was our good fortune that Mr. Allison V. Armour, with his yacht *Utowana*, accompanied by Dr. Thomas Barbour and a group of botanists, made another scientific expedition into these waters and up the West Coast, bringing the plants direct and with special care throughout the voyage, so that they arrived here in excellent condition. The Canal Zone Experiment Gardens and through them all the people of the Isthmus are greatly indebted to Mr. Armour and his party as well as to the United States Department of Agriculture for this assistance in introducing rare and valuable plants into this country. The complete list of plant accessions in this shipment is presented in the unabridged official report.

The journey was continued in Florida over the Tamiami Trail, up the Gulf Coast as far as Tampa and thence over to Orlando through the Citrus belt, examining en route some excellent commercial collections of plants, including many species well worthy of introduction here. A brief call was made at the United States Department of Agriculture Field Laboratory for the Study of Diseases of Citrus and Sub-tropical Fruits. This is located at Orlando. The journey was then continued via Jacksonville to Boston for the purpose of making observations and studies at the Arnold Arboretum, arriving at Boston on the evening of Saturday, August 23.

THE ARNOLD ARBORETUM

The Arnold Arboretum is probably the oldest large and general collection of native and introduced trees under cultivation in America. As such it is of special interest to the Canal Zone Experiment Gardens, yet very young, and particularly in matters of general lay-out, botanical arrangements, records, mapping, etc. Naturally it would not be expected that an out-of-door collection of plants in Massachusetts would afford much in plant material for a tropical country and hence the objective at the Arboretum was not to collect seeds or plants but rather to study these other features to which reference has just been made.

A feature which is apparent as soon as one enters the main gate is

PLATE VIII

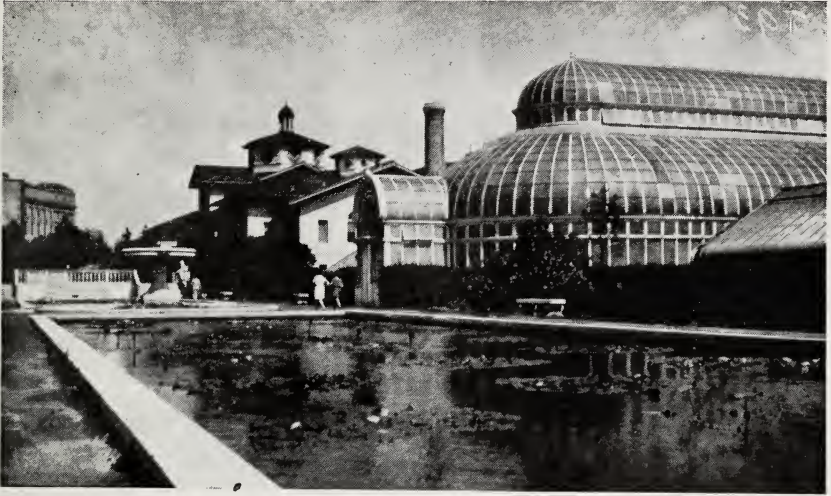


FIGURE 1.—Brooklyn Botanic Gardens, showing some of the main buildings



FIGURE 2.—Tree-moving canvas at the Arnold Arboretum



that although the Arboretum is a highly scientific institution for the culture and study of plants, notably trees and shrubs, nevertheless service to the general public has not been forgotten. Border plantings along many parts of the main avenues have been arranged with such shrubs as will afford a succession of flowers for a long season. Plate VII, Figure 2, shows a vista along one of these beautiful drives, with occasional benches where the visitor may rest and enjoy the scene.

In the matter of arrangement of trees and shrubs, while those closely related are grouped together so far as possible, it naturally has not been possible to maintain a general botanical sequence through the Arboretum. There are so many different conditions entering into the requirements of plants of the same family and even of the same genus that they do not lend themselves well to a wholly taxonomic arrangement.

A valuable piece of equipment in the technique of tree moving was observed at the Arnold Arboretum, in what may be designated as a tree-moving canvas. This appliance which has been used very successfully, in the moving of large trees is shown in Plate VIII, Figure 2. This consists essentially of a piece of heavy canvas eighteen inches wide and twelve feet or more in length, reinforced by heavy ropes, running at right angles across it and sewn securely into folds in the canvas. Heavy brass rings are attached to the ropes at both ends. Through these eyelets or rings, ropes are passed so that when the canvas is put around a large ball of soil, it is possible to draw in on the ropes, thus drawing the canvas under the edge of the soil and also over the top of it. The ball of soil is then further bound with ropes to whatever extent may be necessary to prevent its being broken. The device can be made in any desired length, or two of moderate length may be tied together if desired. Mr. Schmidt, the superintendent of plantings reports very favorably on the success of the device in moving large trees. This equipment is made in Boston and costs about \$20 for one canvas. It would seem that the appliance would be well adapted to use in the Canal Zone where it becomes necessary occasionally to move a large tree with a ball of soil attached. In the tropics where there is no dormant season for most trees and no frozen soil to hold the ball together, some device for preventing the earth from falling from the roots is important.

Other valuable and instructive notations were made among the plantings of the Arboretum.* Professor Jack, Mr. Schmidt and others greatly facilitated the work of this brief visit. I regret having not met

* For a very interesting and complete statement concerning the Arboretum, the reader should consult "America's Greatest Garden—The Arnold Arboretum" by E. H. Wilson, M. A., V. M. H., 1925—The Stamford Company, Boston, Mass.

Dr. E. H. Wilson, at the time Director of the Arboretum, who was absent on official duty and who, a few months later, met a tragic and untimely accidental death.

While in Boston the herbarium of Harvard University and the collections of living plants were visited and also Harvard Museum where was examined the very unique and instructive collection of glass flowers, illustrating, by enlarged forms, the evolution of the flowers of the plant kingdom.

BOTANICAL GARDENS IN NEW YORK AND IN BROOKLYN

After a little less than one week in Boston, the journey was continued to New York for the purpose of making similar observations at the New York Botanical Gardens and the Brooklyn Botanic Garden. In each of these large and well-established institutions it was possible to spend only a few days but very much was found of interest and of value to the comparatively young and undeveloped Gardens of the Canal Zone. The large conservatories shelter many tropical plants and in the extensive plantings out-of-doors were large and magnificent collections of varieties of several flowering plants which have reached their highest perfection in the Temperate Zone but which can be grown even in the lowlands of the Isthmus, and more luxuriantly at the higher altitudes. There were remarkable displays of a very wide range of varieties in dahlias, gladioli, roses, and cannas. Notations were made of varieties for trial in the Zone, for although our work is not primarily with plants of this class, all of them enter into the commercial life of the community and also add so much to the enjoyment of residents and visitors that no opportunity to introduce and establish them should be overlooked. Most of these varieties are obtainable from commercial houses. Plate VIII, Figure 1, shows some of the main buildings of the Brooklyn Botanic Gardens.

An observation which impressed me and which must be mentioned here is the educational use which is being made of the Gardens by the schools, both at the Bronx and in Brooklyn. Also, in New York Botanical Gardens, prizes have been offered for the best designs for cottage gardens of prescribed and very limited dimensions, such as could be found in a suburban residence lot. The prize-winning designs are then worked out in actual plantings and these stand throughout the season as demonstration gardens, at once a source of inspiration and suggestion to all visitors who may have yards that might thus be transformed into similar, although not necessarily identical, beauty spots about the home.

Every courtesy was extended to me by the staff of the Gardens both in New York and in Brooklyn and every opportunity to examine the herbaria and other permanent collections as well as the growing plants in the conservatories and out of doors which show a very wide range of plant life from that of the temperate zone to the strictly tropical species.

Among the many tropical plants under cultivation in the Canal Zone Experiment Gardens, there are at least some not now represented in New York or in Brooklyn, that could be grown in conservatories of the North. Some exchanges have already begun.

CONFERENCES IN WASHINGTON

I proceeded to Washington on September 8 and continued in service there until September 21 in conference with officials of the Department of Agriculture in relation to cooperative and other work in agriculture being carried on in the Canal Zone. By invitation of the Secretary of Agriculture of the United States, I attended a number of the sessions of the "Inter-American Conference on Agriculture," held under the auspices of the Pan-American Union. The fact that this important convention was in session, afforded special opportunity to examine some of the work of the Federal Department of Agriculture, as programs had been arranged for inspection tours to Arlington Farm and other points of interest. Here for example was shown the sugar cane introduction and breeding work of the Department where are grown under glass the varieties of canes introduced as the result of extended explorations in New Guinea and other distant countries. After a period of quarantine, these canes, with others from all cane-growing countries, are being assembled at a recently opened station for sugar cane tests in Puerto Rico, under the Federal Department of Agriculture. The Inter-American Conference offered also a unique opportunity to meet men in similar or related work from most of the Latin-American countries, and from some of the West Indies including Cuba, Haiti, and Puerto Rico. The Conference was considered a great success from the standpoint of the laying of a foundation for mutual understandings, mutual interests in each others problems and cooperative work. A statement of the resolutions covering about two hundred pages has been issued under the title "Final Act of the Inter-American Conference on Agriculture." The resolutions are printed in four parallel columns in the English, Spanish, Portuguese, and French languages. Another important publication issued by the Pan-American Union as a result of the Conference is "Lista Selecta de Publicaciones sobre Agricultura Tropical."

This bibliography covers some ninety mimeographed pages of titles, arranged by subjects, and by authors.

In the conferences at the Federal Department of Agriculture, I called upon the Secretary of Agriculture, the Chief of the Bureau of Plant Industry and the chief of many offices for the purpose of discussing the relation of our work in the Canal Zone to that of the Department of Agriculture.

**Annual Report of the
Canal Zone Experiment Gardens**

FOR THE FISCAL YEAR

1932

LETTER OF TRANSMITTAL

CANAL ZONE EXPERIMENT GARDENS,
Summit, Canal Zone, *July 13, 1932.*

SIR: In the unexpected and unavoidable temporary absence of the Director, I have prepared and present herewith the Annual Report of the Canal Zone Experiment Gardens for the year ending June 30, 1932.

Respectfully,

WALTER R. LINDSAY,
*Supervisor of Cultures,
Acting in Charge.*

Mr. ROY R. WATSON,
Chief Quartermaster,
Balboa Heights, Canal Zone
Through Mr. J. H. K. HUMPHREY,
Assistant Chief Quartermaster.

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ANNUAL REPORT OF THE CANAL ZONE EXPERIMENT GARDENS FOR 1932

BY WALTER R. LINDSAY, *Supervisor of Cultures*
Acting in Charge

INTRODUCTION

The work at the Gardens during the fiscal year just ended has been carried on along similar lines to that of former years. A great many valuable plants have been disseminated throughout the Canal Zone, Panama, and the surrounding countries. Plant and seed exchanges have been carried on with experiment stations, botanic gardens, and individuals in different parts of the world. Thus numerous valuable introductions have been made. Since water is available in all parts of the Gardens, several hundred new plants were placed in their permanent locations. Each year many new plants or trees are fruiting or flowering for the first time. At present the Experiment Gardens possess the largest orchard of fruiting mangosteen trees that exist on the American continent.

PERSONNEL

For some years past the Director of the Experiment Gardens has been trying to secure a trained man to prune and train the trees in the various townsites. This work has never been properly done, and consequently many trees have been lost or misshapen. In January 1932, Mr. John P. Keenan, a local young man who has had two years college training in this work and some experience with the Department of Agriculture and the United States Forest Service, was secured for this position. On January 20, 1932, he took up his duties as Agricultural Aide attached to the organization of the Experiment Gardens and under the direct supervision of the Director.

Mr. Keenan's work has been greatly appreciated as shown by the constant demand for him in the different districts. Since January he has spent the major part of his time in the Balboa District. He has also done considerable work in Cristobal, Naval Air Base at Coco Solo, and in the Pedro Miguel District. Practically all the work he has done so far, with the exception of the training of the young trees in the Gavilan Area and along Amador Road, has consisted of the treatment of old trees which have been suffering from neglect for years.

VEGETABLE PROJECT

Every year the Experiment Gardens have numerous requests for vegetable seeds and information regarding vegetables in this region. Although the Gardens have confined their efforts chiefly to the establishing of more permanent plants and have not been able to conduct any extensive experiments in vegetable culture, some simple tests have been made as a means of securing first-hand information to meet these inquiries.

In January, seeds of summer squash, variety "Paddy Pan," muskmelon, and watermelon, were planted. The squash grew very rapidly and produced an average of about twenty-five pounds per plant of beautiful fruit before the rains started in May. Each fruit was considerably larger than those received from the States and sold in the Commissaries. During the rainy season the squash continued to produce an abundance of fruits but the fruits became so badly infested with *Diaphania* (the pickle and melon worms), that regardless of our efforts, none of the fruits were marketable. Up to the present time no effective control for these worms has been noted.

The muskmelons did as well as the summer squash during the dry season, each plant producing three distinct crops of fruit and each crop having an average of eight fruits per plant. Most of the fruits of the second and third crops matured during May and were infested with larvae of the melon fly. Thus the melons were not marketable. It seems quite probable that by planting early (the latter part of October), two very good crops of melon should be expected before the rains commence in May.

The watermelons made a very excellent growth but were slow in setting fruit. A good crop finally set, however, but never matured as the vines were killed in May by disease. Spraying about once a week would have been required to have kept the watermelon vines in a healthy condition. This would certainly not be profitable. It is possible that watermelons could be grown here profitably if they were planted early enough to have the fruits ripen during the dry season.

In March the Landreth Seed Company, Bristol, Pennsylvania, sent the Gardens the following vegetable seeds: Six varieties of sugar corn; nine varieties each of bush beans and tomatoes; seven varieties of peas; four varieties of peppers; two varieties each of squash, spinach, and pumpkins, and one package each of ruta-baga, kale, and beets. It was desired that these seeds be planted and a report made of their growth and success or failure.

It is still too early to give a comprehensive report upon these vegetables. However, a report can be made of the following:

The tomatoes, peas, and spinach showed nearly one hundred percent germination, but died off very soon afterwards.

The bush beans are growing nicely and are very prolific. Up to date over six hundred pounds of beans have been harvested for which the Commissary paid from nine to twelve cents a pound. The crop has not been entirely harvested yet.

MANGOSTEEN

The mangosteen (*Garcinia mangostana*), as noted in previous reports, is growing exceptionally well at the Gardens. Trees which fruited in 1931 for the first time are producing considerably more fruits this year than last. There are also several trees coming into fruit for the first time this year. There is much interest on the Isthmus in mangosteen trees; consequently all available seed is being planted. It will be possible to disseminate approximately one hundred plants during the present year.

ROSES

Among the outstanding introduction to the Experiment Gardens during the past year was a large collection of roses from the Brooklyn Botanic Gardens, New York. These roses, shortly after their arrival, were budded on three types of root stocks, namely, Haitian or Savage, I. X. L., and Native Red Rose. Notes were taken at various intervals comparing the growth of the varieties on each of the stocks. The purpose of this experiment was to find a superior type of root stock suitable to conditions on the Isthmus. Very little difference has been noted between these stocks so far, but it is during the rainy season that the differences are most likely to be seen. The roses, to a large extent, were varieties new to the Isthmus and have been received with a great deal of enthusiasm.

GRAPES

In February, 1929, a strain of the Isabella grape was introduced from Hawaii. This grape, which is a subtropical fruit, does very well in Hawaii, often producing two crops a year, and should be tried in this region. This variety is making only fair growth at the Experiment Gardens and elsewhere in the Canal Zone and in Panama.

SUGAR CANE

The growing of introduced varieties of sugar cane for distribution among the cane growers of Panama has been continued along the lines

indicated in former reports. One of the chief objectives in this work is to find choice canes, well adapted to the conditions in Panama, and resistant to the Mosaic disease which has been devastating most of the cane fields of the Isthmus. Most encouraging reports have come in from the plantations concerning some of the varieties, notably the P. O. J. numbers 2725, 2727, 2878, and 2714. Santa Cruz 12 (4), EK 28 and H 109 have also been reported as doing very well and are worthy of mention here. Undoubtedly there will be other varieties added to this list when those varieties, listed elsewhere as having been introduced from Puerto Rico, become established here.

INSECTS AND PLANT DISEASES

As has been said in a former report, the Gardens do not attempt to carry on any technical entomological investigations, and all problems in the identification of insects are referred to Mr. James Zetek, Associate Entomologist of the United States Department of Agriculture, located at Balboa. Mr. Zetek has identified many insects, some of which cause considerable trouble at the Gardens as well as elsewhere on the Isthmus. For this reason brief mention is made herein of a few such problems as seen from a horticultural rather than from an entomological viewpoint.

One of the most serious insect troubles during the past year was caused by one or more species of *Diaphania* (*Lepidoptera Pyraustidae*), the larvae of which enters melons, cucumbers, and other cucurbits, thus destroying hundreds of dollars worth of these fruits every year. No effective means is known by which these larvae may be combated. Spraying with arsenates is of very little value. In the North where the climate is cold, early planting gives some protection. The planting of squash as a trap crop also aids some but does not give complete satisfaction. Once these moths get established in a locality the best thing to do is to burn every cucurbit, including vines and leaves, and not plant them again in the same plot for at least two years.

A considerable number of citrus fruits, principally oranges, were destroyed by what appeared to be a yeast-like fungus. From all external appearances the fruit seemed to be in excellent condition, but upon cutting them they were found to be exceedingly dry and in many instances had large brown discolored areas. The fruit was thus worthless. The assistance and cooperation of the pathologists of the Bureau of Plant Industry, United States Department of Agriculture, Washington, was solicited and was gladly extended to the Gardens. Consequently, two dozen specimens of oranges were preserved in three

percent formalin and sent to Washington where they were given a careful microscopic examination by citrus pathologists. These pathologists reported that they did not find any evidence of infection by yeast, bacteria, or filamentous fungus, and that they were quite certain that the condition of the fruit was not caused by the *Nematospora* which is prevalent in certain tropical citrus-growing sections.

The papaya fruit fly, *Texotrypana Carvicauda*, is still doing considerable damage to the papaya industry. Eggs of this fly are deposited within the fruit at almost any stage of development. Fruits in which eggs have been successfully deposited may fall off prematurely, but if the papaya is nearly mature when stung it may remain upon the tree until ripe. Unfortunately it is not always possible to distinguish infested fruits by their external appearance; thus not all stung fruits can be detected and destroyed. Seemingly the only solution to the problem is to grow varieties of papaya that are not susceptible to the attack of this fly. The varieties with thick flesh offer much resistance.

PUBLICATIONS

The Annual Report for 1931 was not printed owing to lack of sufficient funds. It is hoped that it can be published this year in conjunction with the 1932 report as there have been a great many requests for the Experiment Gardens' Annual Reports.

A revised mimeographed list of plants for sale at the Canal Zone Experiment Gardens was issued and distributed locally and to correspondents in the neighboring Republics. This, as in the case of the earlier list, was not sent out to the general mailing list in the United States and foreign countries as most of the plants covered in this enumeration are intended for use on the Isthmus or in nearby locations and cannot easily be shipped long distances by mail. A copy of this will be mailed to any botanic garden or experiment station, if requested.

NURSERY OPERATIONS AND SALES

The operation of the nursery as a separate and self-supporting department, carried on at the Gardens under the Revolving Fund, has been explained in earlier reports. It has proved to be a very important service to the people of the Isthmus and neighboring countries.

Until recently Mangosteen seedlings have been very difficult to raise. Formerly they were planted in tin cans or clay pots and less than fifty percent of the seedlings ever reached maturity. In February 1931, Dr. Wilson Popenoe visited the Gardens and related very successful

experience in planting out very young seedlings into nursery rows. Consequently very young seedling trees were set out early in May. These young plants have made excellent growth and are ready to be planted out in their permanent places. It appears to have been fully demonstrated that young mangosteen seedlings are retarded by root confinement.

EXTENSION ACTIVITIES

The Gardens, through the Director, have continued to render service to the Canal Zone towns, the United States Army posts, and the Fifteenth Naval District, by way of advice concerning planting plans for new areas and in relation to the care of trees, shrubs, and vines, in the older and more established settlements.

BUILDINGS AND CONSTRUCTION

Building No. 12, near the Panama Railroad Station, Summit, which was formerly occupied by the Cattle Industry, was turned over to the Experiment Gardens to be used for an office. After some reconstructing by the Constructing Quartermaster, the building was ready for occupancy about the middle of May. Due to lack of sufficient funds, only half of the building was renovated. However, the new office is more convenient, better ventilated, and has considerably more storage space than the old office.

During the past year an overhead irrigation system has been installed in all of the plant houses and in the cutting nursery. Not only is this a great saving in labor during the dry season, but it insures a much more uniform and efficient distribution of water than is possible by the use of the hose. The effects are readily seen in the plants.

A new galvanized iron pipe and wire trellis was constructed on the west side of the greenhouse to accommodate a number of new vines received within the last year. The metal trellis has proven itself to be the most economical type for use in this part of the tropics, primarily because of its resistance to termite attack.

REPORT OF PLANT COLLECTION TRIP IN FEBRUARY AND
MARCH 1932By J. E. HIGGINS, *Director*

On February 14, 1932, I sailed from Cristobal on the S. S. *Crijnsen* for La Guayra, Venezuela, calling en route in Colombia at Cartagena and Puerto Colombia, at Willemstead, Curacao of the Dutch West Indies, and Puerto Cabello, Venezuela. Short trips were made from each of these ports as time would permit, including a brief visit at Barranquilla from Puerto Colombia. At most of these points of call, even in the very short time available, it was possible to get seed of some plant or plants of value and not yet represented at the Experiment Gardens. Among these was a handsome flowering shade tree, a species of *Cordia* (probably *C. sebestina*) related to the "Laurel" of Panama, the latter a white flowered tree rather conspicuous when in full flower towards the end of the dry season. The species of which seed was collected in Curacao and seen also in Colombia and Venezuela, was found in two varieties, one bearing orange-colored flowers and the other red. The trees appealed to me as worthy of special consideration because they were holding abundant dark green foliage during the dry season and were also in flower. The dry season was well advanced and these trees, wherever seen, were showing a very high degree of drought resistance. In Curacao where the seed was collected, the most conspicuous plants in the natural landscape are Cacti indicative of the prolonged drought which characterizes the climate of Curacao.

A drought-resistant hedge plant, bearing violet-colored flowers, also attracted attention and supplied seed for testing at Summit. This is a *Barleria*, related to the yellow-flowered, moisture-loving species of this genus, found in Panama. The plant of which seed was collected may add variety to our somewhat limited list of hedge plants in common use, and particularly in places where some other kinds would suffer from insufficient moisture.

Fruit of a palm, probably a species of *Bactris*, but thought to be different from those of Panama, was found in the market at Cartagena and was brought for trial in the Canal Zone.

Arriving at La Guayra on the morning of February 20, I went at once by automobile to Caracas which is located in a very beautiful valley at an altitude of about 3,000 feet, with a flora affording plants that may be of use at such altitudes in Panama or elsewhere in this region, as well as others that will also prosper at lower elevations.

Seed of a quite unusual variety of citron was collected in the market. Unfortunately the time was too limited to trace these fruits back to the trees from which they came and to secure budwood which would be the only way of making certain of establishing the variety. The fruit was of large size, elongated, with very smooth surface and thick rind, as is required for commercial citron peel such as is imported into the United States in considerable quantities, in brine for use in the manufacture of confectionary.

Besides other things of interest but of minor horticultural importance, I collected seed of a cypress tree (*Cupressus sp*) which may prove to be of value.

To one interested in flowers, the flower section of the Caracas market place, in the early morning, is well worthy of a visit. Here are to be found many kinds of flowers familiar to travelers from the temperate zone, for the altitude of 3,000 feet gives the necessary coolness required by many such plants. The most impressive flowers in the market, however, are the huge and gorgeous orchids, *Cattleya labiata*, which in the cities of America or Europe would be the proud possessions of only the very wealthy, but are anybody's flowers in Caracas.

At Caracas it was my pleasure to meet Dr. H. Pittier, the distinguished botanist formerly of the Smithsonian Institution in Washington, D. C., and who has done so much to increase the knowledge of the flora of the region of which Panama is the center. I am very grateful to Dr. Pittier whose courtesy greatly facilitated my observations during the three days spent in Caracas and its immediate vicinity.

On February 23, I sailed for Puerto Rico which was the chief objective point in plant collection because of the fact that the island, with its several experiment stations for agriculture and forestry, has accumulated a large number of introduced species and varieties and has also developed varieties of much promise especially in sugar canes.

I arrived at San Juan on the morning of February 25, and continued in plant collection and consultations with agriculturists until the evening of March 11, when I sailed for Cristobal with the shipment of plants contained in one wardian case, five boxes, and one package. The shipment was by the Spanish Line, Compania Transatlantica de Barcelona, via South American ports and Curacao, and arrived at Cristobal on March 19. The plants were very carefully packed, received good care en route, and arrived at Summit in excellent condition.

The plants were again carefully examined, and as an extra precaution against the introduction of any plant diseases or insect pests, all plants and cuttings were dipped in a combined insecticide and fungicide, immediately after removal from the boxes. In all plant introductions

it is extremely important to take precautions against the accidental introduction of pests along with the desired plants.

Among the most important economic plants in these introductions, were several varieties of sugar cane new to Panama. These included varieties P. R. 303 and P. R. 807, both originated at the Experiment Station at Rio Piedras; F. C. 998 and F. C. 916 originated at the Farjarde Central in Puerto Rico; and the Java seedling P. O. J. 2952. Only a very few selected cuttings of each of these were included in the shipment in order to make possible thorough examination and to avoid the introduction of cane diseases or insects. With present methods of propagation, the multiplication of a variety can be effected so rapidly that there is no need of more than a very few cuttings at the beginning.

In Puerto Rico, prolonged tests with a large number of varieties of sweet potatoes have resulted in the selection of a very few for further general propagation. Of these, the varieties Totiempo and Key West appear to be the most promising and combine unusually heavy yields with good quality. I brought one tuberous root of each of these varieties and these have already sent out shoots which will insure the propagation of the varieties here. Sweet potatoes should be more generally grown on the Isthmus and it is hoped that these varieties may be of value in extending cultivations.

Cuttings were obtained from a species of *Tamarix* (common name Tamarisk). This is a small tree that may prove of special value for planting near the seashore in New Cristobal and other localities where there are heavy winds with salt spray. In such locations, trees of *Tamarix* seem to thrive while most other kinds of trees are retarded or killed by the salt. The genus *Tamarix* is also interesting as the source of medicinal elements and it also yields vegetable dyes. One species of *Tamarix*, when punctured by a certain scale insect, yields a substance known as "Manna" similar to that produced by some European ash trees and supposed to resemble the manna referred to in Biblical literature in connection with the wandering of the Israelites in the wilderness after their escape from Egypt.

The *Tamarix* trees are readily propagated by cuttings. Those that were brought back from Puerto Rico show indications of growth.

Lemasa, Champada, and Champeden are common names, as used in the Dutch East Indies for *Artocarpus polyphemia* (*A. champeden*), a relative of the Jackfruit but said to be far superior to the latter. It was introduced into Puerto Rico some years ago by Mr. O. W. Barrett. The trees at the Trujillo Alto Substation have come into bearing and

from these seed was supplied. This should prove to be a well worthwhile acquisition to the list of tropical fruits in the Canal Zone and Panama.

Seed of a white gandule (*Cajanus indicus*), said to be very superior for table use, was obtained. It is reputed to be very much more delicate in flavor than the usual varieties. As the gandule is a standard food and very commonly used, this new variety may prove to be valuable.

Many varieties of taro (*Colocasia esculenta*) have been introduced and established in Puerto Rico. This plant, which is native to Malaysia and Polynesia, has long been the chief food supply of the natives of the Pacific islands and is highly esteemed by Caucasians as a most nutritious and very palatable food. It is so easily digested that physicians frequently recommend it for invalids. Some of the varieties as grown in Trinidad are known as Dasheens. Twelve selected varieties of taro were received from the United States Agricultural Experiment Station at Mayaguez, P. R., for trial at Summit. This country is in need of a wider range and larger supply of vegetable foods which can easily be grown by the native farmers. Perhaps some of these taros will aid in this diversification and increase in food supply.

Many handsome ornamental plants were included in the collection among which were twenty-seven named varieties of Dracena (*Dracaena spp.* and *Cordyline spp.*) Dracenas, with their erect stems and showy foliage, prosper in Panama and the Canal Zone and are much admired here. The new kinds will add variety and beauty to the landscape.

The same may be said of the new croton (*Codiaeum*) and Hibiscus varieties which were brought from Puerto Rico.

The Traveler's tree (*Ravenala madagascariensis*), sometimes called the Traveler's palm, is a most unusual object in the landscape presenting its banana-like leaves in fan-shaped formation. Trees of this kind are well established at Summit and elsewhere on the Isthmus and always attract the attention of local visitors as well as those from abroad. There is a considerable demand for plants which it has not been possible to supply because the Traveler's tree is tardy in fruiting and none of our trees have yet produced seed. The tree is reproduced also by offshoots but these are few in number. We were fortunate therefore in being offered some seed by Mr. T. B. McClland, Director of the United States Agricultural Experiment Station at Mayaguez, to whom we are indebted also for a large number of the new kinds of plants brought from Puerto Rico.

The climbing Star Jasmine (*Jasminun pubescens*) is a very graceful and attractive climber with white flowers during most of the year. Efforts have been made in years past to get this Jasmine. Several plants were supplied by the Federal Station.

Many other species or varieties of tropical plants were included but cannot be specifically mentioned in this brief report. There were in all 128 new accessions in the shipment resulting from this trip and other kinds will follow as they become available.

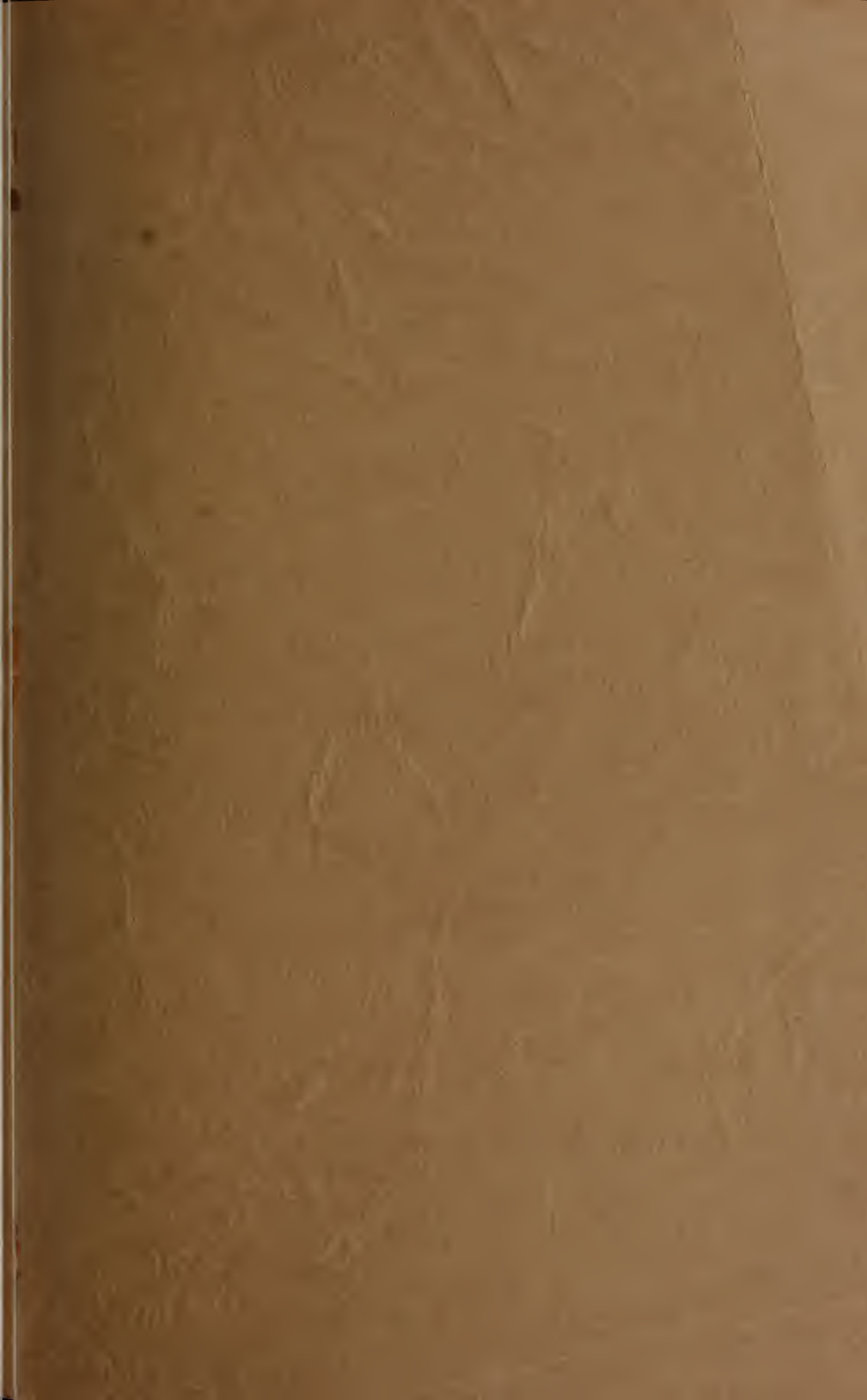
Special mention must be made of our obligation to the various organizations which not only supplied plants and propagation material but also extended many courtesies which greatly facilitated the work of collecting, packing, and shipping. These include the Insular Department of Agriculture with several of its branches and substations, especially the Insular Experiment Station at Rio Piedras, and the substation at Trujillo Alto which has already been mentioned; the Puerto Rico Forest Service; and the Federal Experiment Station at Mayaguez. A very fine exchange collection of Dracenas and other plants was received from the North-South Nursery Company located near Rio Piedras. Dr. E. W. Brandes, Principal Pathologist in charge of the Office of Sugar Plants of the United States Department of Agriculture, who was in Puerto Rico at the time of my visit, kindly offered the assistance of his office in sending to the Canal Zone Experiment Gardens, disease-free sugar canes of several varieties direct from Washington.

Due to the assistance of all of these institutions and the several members of their staffs, this brief trip was a very highly successful plant collecting tour and has added much to the interest of the Gardens as well as to the economic plants of the Isthmus. As years pass and these plants mature and are disseminated, their real value will be even more highly prized.

The very fortunate fact that my stay in Puerto Rico was coincident with the Conference of the International Society of Sugar Technologists which was being held at San Juan, made possible a few personal conferences with technical men in the sugar industry in different parts of the world.







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